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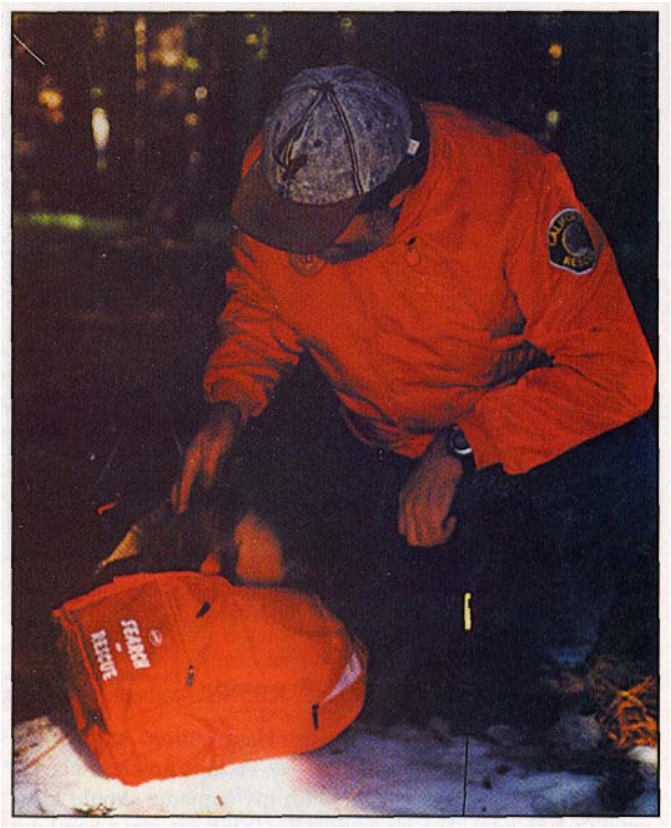
Personal Locator Beacons Upload GPS Positions!

It's been three years and over a thousand "saves" since the personal locator beacon (PLB) was authorized by the FCC for use by the general public for land, sea, and air applications. These lightweight handheld distress beacons transmit a 25-milliwatt undulating warble on 121.5 MHz, and more important a 5-watt data burst on 406 MHz to low earth orbit (LEO) satellites and one of three geostationary satellites. These satellites are part of the search and rescue satellite-aided tracking system called COSPAS-SARSAT. Currently, there are six LEO satellites and five geostationary satellites, all listening in on 406 MHz frequencies (406.025 MHz, 406.028 MHz, and 406.037 MHz).

LEO satellites, on February 1, 2009, will turn off their simultaneous relay of received 121.5-MHz signals. More than 95 percent of 121.5-MHz high-power emergency beacon signals were false activations, and the signal itself carries no user identification.

Meanwhile, the 406-MHz Emergency Position Indicating Radio Beacons (EPIRBs) still include a 121.5-MHz homing signal, but this signal is only 25 milliwatts and is intended specifically for local search and rescue tracking. The main 5-watt signal is a 406-MHz data burst containing your unique identification number (UIN) that would allow a rescue coordination center to access the NOAA beacon database and *immediately* determine the beacon's country of origin and the registered owner along with a phone number.

The six LEO satellites monitoring the 406-MHz data burst will also begin downloading Doppler shift measurements for an approximate position of the activated 406-MHz data burst signal. While the signal is immediately detected by the geostationary satellite and transponded to a local user terminal (LUT) ground station, it takes nearly an hour of Doppler shift calculations from the LEO satellites to develop a position fix within 2.3-nautical-mile radius of the activated beacon. This is infinitely faster and more precise than an older 121.5-MHz calculated position, 12-nautical-mile radius, over a six-hour period, requiring a search area of 452-square-nautical miles!



This injured hiker activated the PLB (foreground) and placed it in the clear for a successful rescue.

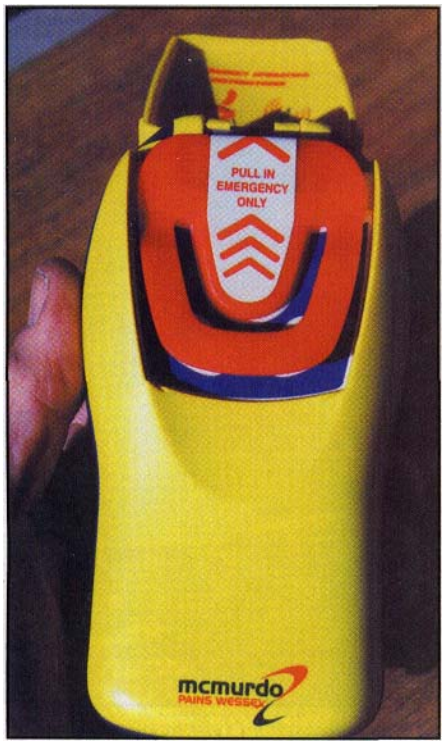
Technology That's Come Into Its Own

The 406-MHz calculations cut the search area *dramatically*. Equipment has also improved over the first issue personal locator beacons, produced by ACR Electronics in Florida and McMurdo in Europe. The personal locator beacon acceptance among skiers and hikers was modest for the first couple of years after the FCC authorized the equipment, but with the new development of built-in GPS, the PLB life-saving beacon's popularity has exploded.

"Here at ACR, our experience in the marine EPIRB business, that includes models with a built-in GPS, allows us now to self-contain the GPS engine in a tiny personal locator beacon, which we call AquaFix, just as much a land PLB as it is out on the water..." says Paul Hardin of ACR. "The once-a-minute data burst may now include latitude and longitude coordinates that are instantly relayed by GEOS AR geosynchronous high-earth-orbit satellites. With your identification and location known from the moment the first signal is received, your call for help is quickly routed to the closest appropriate rescue agency," adds Hardin.

The GPS signal eliminates the six-hour waiting time required for the traditional 121.5-MHz signal to LEOSARs (Low Earth Orbit Search and Rescue). On average, the waiting time to a 406-MHz accurate fix is about 60 minutes. With a GEOSAR (Geostationary Search and Rescue) reception of your 406-MHz data burst latitude and longitude, your position fix is nearly instantaneous. This is critical if your climbing party is involved in a life and death situation.

It's no easy matter for a shirt pocket 24-hour signaling PLB to obtain an accurate 1695-MHz GPS position fix. The built-in GPS must offer exceptional sensitivity in order to receive the distant satellite signals, and develop that position fix without unduly draining the PLB 24-hour continuous duty power supply. Remember, even though the 5-watt UHF data burst only occurs for half a second, just under every minute the 121.5-



Here's a small PLB with built-in OPS.

The ACR Direction Finder in a real 121.5-MHz track-down along a popular river rafting route in a remote area.

MHz, 25-milliwatt locating signal for ground units is constantly tugging on battery capacity.

Being able to obtain GPS position fixes in canyons or in densely wooded areas of the country was a major accomplishment for ACR. Getting a 5-watt, 406-MHz data burst up to LEOSAR and GEOSAR satellites is not nearly as difficult as receiving a constellation of spread spectrum, ultra-low-power GPS signals passing in six orbital planes inclined 55 degrees, four GPS satellites per orbital plane, out 10,000 miles plus, according to technical crew reps attending the recent Radio Technical Commission for Maritime Services (RTCM) beacon manufacturers workshop in Newport Beach, California.

There's even more good news from the RTCM beacon workshop: airborne rescue agencies have just announced the acquisition of 406-MHz automatic direction finders, capable of locking in on a signal that only provides a 500-millisecond data burst. This line of position would allow more precise homing than traditional equipment at 121.5 MHz. However, the 121.5-MHz homing signal is still important for ground search and rescue crews using 121.5-MHz equipment like the ACR portable direction finding homing kit.

A Place With A View?

According to the United States Air Force, which is tasked with on-land rescue coordination, it's important for land users of a personal beacon equipped with a built-in GPS to understand how to get their equipment positioned for a clear shot at the sky. If a PLS is activated in a dire emergency situation, the beacon MUST be removed from a pocket or pouch and physically held away from the body and in the clear. If the victim holding the PLB is able to position himself in a clearing without trees overhead, the greater the likelihood of GPS reception for a GPS 406 MHz encoded position fix.

And while LEO satellites could ultimately approximate the position of the 406 signal *without* a good GPS fix, a good fix would *dramatically* decrease the time to pinpoint the exact 100-yard radius of the activated signal. There is no in-between on a GPS reception fix; either you get a fix that is "dead on" or a partial position fix due to some satellites blocked by the body, which will result in no report rather than a slight error in latitude and longitude. While multipath propagation can indeed play a factor in a good GPS fix, it's seldom a problem in rural regions.

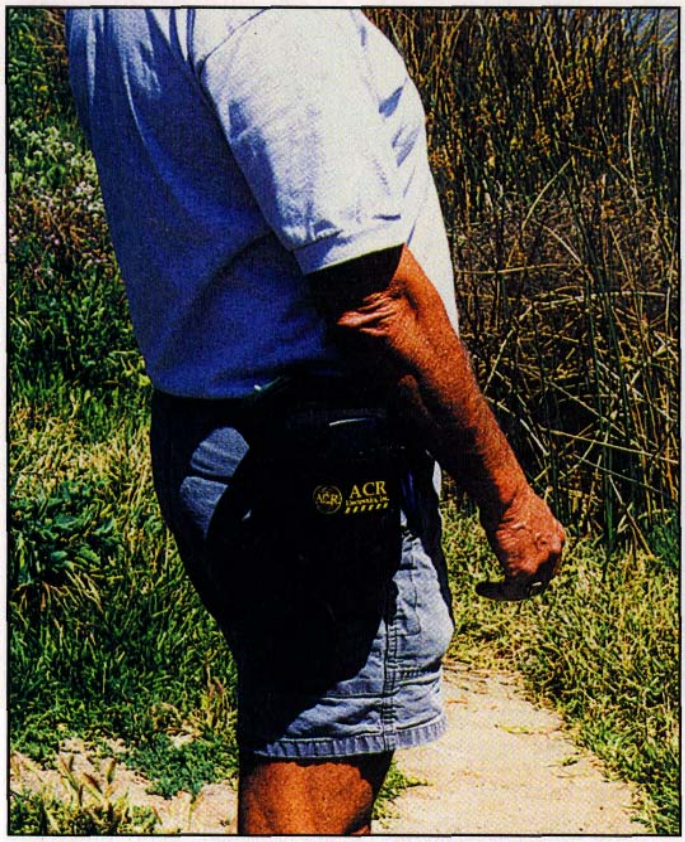
An injured hiker has a better chance of improving a PLB GPS position fix by crawling to the top of a small hill or placing the equipment on a rock out in the open. Hugging a PLB for all its worth would be the same as putting your hand over the patch antenna on your little portable GPS; signal strengths to eight satellites will drop to zero. So our on-land advice is to GET THAT BEACON IN THE CLEAR!

Boaters should also remember that the PLB must be held out of the water and vertically for best GPS reception and LEOSAR and GEOSAR satellite acquisition. While most PLBs will float, they don't float in a position to keep their antenna systems properly oriented to the sky. PLBs will operate for 24 hours, which could give you (on land) several opportunities to try different locations to get your signal up to the sky.

Remember, the latitude and longitude reception, along with your ID, takes place at a geostationary satellite, 22,000 miles up. Doppler shift measurements on your 406-MHz signal need only go about 50 miles up.

The Human Connection

"It's vitally important that the new personal locator beacon gets registered to a live phone number," says Hardin. The contact information in the 406-MHz data burst will contain beacon ID information along with country code, your home address, e-



PLBs are small enough to wear, but they must be placed out in the open to signal satellites.

The test signal on 121.775 was increased by 3 dB by placing the test PLB on a water groundplane.

mail, and a telephone number to someone LIVE—not an answering machine—that can tell rescue agencies that you are indeed out on a hiking trip in the High Sierras.

If you list only your own phone number, your answering machine may pick up and say have a nice day and leave a message. NOT GOOD! Put down a phone number for rescue agencies to contact a person who has a cell phone on 24/7 and who knows you're out on a trek. A "Hi there. This is John and I'm on vacation for another week. Please leave your name and number and I'll get right back to you on my return" message won't cut it! That phone number won't give rescue agencies a true heads up that you are out on the trail and likely sending a call for help. You register online at www.beaconregistration.gov.

Avoiding Accidental Activation

Accidental activations occur most often when magnetic shake-up flashlights are placed together with PLBs. The large magnet in the flashlight triggers the PLB magnetic switch, and unless you're looking at the PLB, you won't realize it's been activated, even though the mechanical switch shows OFF.

Regarding this, John Bell of ACR Electronics told us,"... we have taken steps to reduce those false activations. Our PLB 200-201 does not rely on magnetic reads for activation—they are pressure sensitive switches and are not subject to the influence of magnets. Our other EPIRBs that do use magnetic reads have had additional reads added to the off position." He continues, "For the last year and a half, two conditions must be met to activate the EPRIB. Switch out of the OFF position and magnetic presence in the ON position. (EPIRBs will still activate when out of their bracket and wet). Since this change we have not heard of any false activations while beacons are being handled in the supply chain. Electronics dealers would store EPIRBs next to stereo speakers causing false activations!"

For added peace of mind, you can also put down your itinerary on the online registration form and change it regularly as you travel with your PLB with built-in GPS. This would further validate an activated signal as a real call for help, not an accidental activation.

A Life-saving Last Resort

Both ACR Electronics (www.ACRElectronics.com) and McMurdo (www.mcmurdo.co.uk/) PLBs with built-in GPS positioning and signaling capabilities are priced below $700. Although you could save $100 by getting a PLB *without* GPS reception, I would recommend getting the GPS receiver built in. While you *could* tie in a GPS external receiver to your PLB, this introduces a lot more wires, and more complications when trying to hold both units up for signaling.

The new breed of PLB with built-in GPS has been thoroughly tested by independent agencies, like the Equipped To Survive Foundation (www.Equipped.org), and their findings are positive. Eventually, I foresee, all PLBs, marine EPIRBS, and all Emergency Locator Transmitters (ELTs) will include GPS internal receive with position encoding on one of the 406-MHz channels.

The PLB is an absolute last resort signal. And emergency responders need to send the word, loud and clear, that no PLB shall be activated except for an absolute life and death situa tion. Huge amounts of resources are mustered for a 406-MHz call. Let's hope that call also includes your imbedded GPS position fix!

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